TARIQ KHRAISHI, Ph.D.
after having been first duly sworn under oath,
was questioned and testified as follows:

EXAMINATION

BY MR. ERICKSON:

Q. Would you state your full name for the record, please?
A. Tariq Khraishi.
Q. And what do you do for a living?
A. I am a professor of mechanical engineering at UNM.
Q. Okay. Have you ever had your deposition taken before?
A. I did, yes.
Q. And how many depositions have you been involved in, to your recollection?
A. I believe two.
Q. Okay. Let me just go over some basic guidelines so we are on the same page.
A. Yes.
Q. I will be asking you questions today.
A. Okay.
Q. You should be careful to try not to speak while I am speaking, and I will try to do the same while you are speaking.

Q. Where was that?
A. Washington State University.
Q. Okay. In your role as a professor of mechanical engineering, do you assign engineering problems sets to your students?
A. Yes.
Q. And what are your requirements for grading the work that is done when you assign engineering problems sets to your students?
A. What are my requirements? If they want full credit, they need to show full work.
Q. Okay. And tell me what that means, to "show full work."
A. If they got the right methodology and answers, that's called "full work."
Q. Okay. And so I take it you require them to show the full work that they do to analyze the problems set that's been put before them?
A. It could be different methodologies. It doesn't have to be -- I am not rigid on the specific one. If it's technically sound methodology, you know, that's good, if they are aware of different ones, but the answer is typically, because these are very specific type problems, normally, they have one answer.
Q. Okay. And you require them to show you the

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work that they did to get to that answer; is that correct?
A. Yes, of course, they have to show work, not just put an answer.
Q. So, for example, if they have run calculations, they have to show you the calculations they ran; is that correct?
A. If they run calculations, for example, yes, they have to show those calculations.
Q. And if they use a particular method or technique to analyze the engineering problems set, they have to show you that, as well; is that correct?
A. Yes.
Q. And they have to tell you engineering principles that they employed in the process of reaching their conclusion, as well; is that right?
A. I mean, typically, the principles are embedded into their math and equations. So they don't necessarily explicitly name the principle, but they -- because that's part of normally a specific class where they are all taught about those specific principles.
Q. Okay.
A. So I don't necessarily tell them, "Give me the name of it," per se, because the equation, many times, relates to that principle, or equivalent of that

principle.
Q. Okay.
MR. TRAVERS: Is there a time that we can have a break? We have been going about an hour. I do need some coffee.
MR. ERICKSON: Okay. We can take a break now.
MR. TRAVERS: Okay. Thank you.
(Recess taken from 10:02 to 10:11 a.m.)
MR. ERICKSON: Back on the record.
Q. (By Mr. Erickson) So, Dr. Khraishi, can you tell me what mechanical engineering tools and methodologies you used in evaluating the issues in this case that we are involved in today?
A. The principles of fracture mechanics, materials science also.
Q. Okay. Principles of material science?
A. Yes, material science and manufacturing/design. They are normally interconnected. Slash meaning it's -- yes.
Q. Meaning /stress design?
A. Design, yes.
Q. Okay. Any other methodologies that you employed in analyzing the problem in this case?
A. I'm trying to think. I mean, evidence,

what do you call it, martensite, m-a-r-t-e-n-s-i-t-e, phase, p-h-a-s-e.

And, anyway, the martensite phase could form -- it could form more on certain materials than others. Also, the heat treatment, for example, as it relates to cooling rates, could also cause a more brittle phase like the martensite to form, and that could cause breaking things easier, like the welds and the metal and so forth where the welds are.

Q. And which source did you rely on for the discussion of embrittlement that you are describing?

A. The Materials Science --

Q. Okay.

A. -- book.

Q. Were there any other principles of fracture mechanics that you applied in this matter besides what you just described to me?

A. This is not principles of fracture mechanics. This is the causes of embrittlement. And then after that, if you have an embrittled-type material that causes it to fracture easier, to break easier, in other words, and yes, I utilized another one, because in this particular case, their welding process was not done right and it caused an ingress, "ingress" meaning like a small fracture end, small

groove.

An ingress, i-n-g-r-e-s-s, caused an ingress into the metal, the links, metal links, and that metal link combined potentially with embrittlement in the microstructure, meaning a martensitic or hard phases caused things to break down, to fracture easier, and when that fracture happened, it destabilized the structure, meaning it would tilt it to, you know, a certain number of degrees that would cause instability for somebody unexpecting who is stepping on it.

Q. And we are going to get to your opinions, Dr. Khraishi. Right now, I am just trying to understand the methodologies that you used.

A. (Witness nods head.)

Q. And so my question was just, are there other methodologies that you employed --

A. Yes. The principles of fracture --

Q. Let me finish my question.

A. (Witness nod head.)

Q. Were there other methodologies that you employed under that heading that you gave me of "fracture mechanics" to analyze the problems here other than what you just told me?

A. Yes. Yes.

Q. What?

A. Yes. I mentioned another one, which is also the type of steel that is being welded. There are some that are more prone to formation of those hard phases at the micro level, and some are not. Again, I mentioned that earlier.

Q. Okay. I am having a hard time understanding how that's a methodology. I mean, that sounds like knowledge that you have about materials science, but I am asking more about methodologies that you used to analyze these problems, not so much right now the specific knowledge that you have from materials science.

A. Yes.

Q. But more methodologies.

A. I mean, if you're referring to simulations like we were talking earlier, I did not do a simulation, if that's what you are trying to --

Q. And why didn't you do a simulation?

A. Because I saw in the evidence enough to support my opinion how things transpired in terms of all my expertise and knowledge in these areas.

Q. Okay. The third --

A. Normally, we do simulations when you have to, when you think -- because the simulations are expensive to do. You don't resort to it unless you think there

used to evaluate manufacturing/design concepts?

A. Is the welding process.

Q. All right. And how is that a methodology?

A. So methodology -- again, I don't know what you are trying to refer to in the "methodology," if you're referring to simulations or not, but, you know, in this particular case, again, the welding, they did it in a way where, you know, the welding spots were -- would end up reducing an ingress.

So that's part of -- the designers of these stairs or steps, they need to think ahead of time where is the placement of welds and how that would cause ingresses or not, because those ingresses, again, could, according to fracture mechanics books, could cause further fracture and further breakage.

So that's, again, part of what people in manufacturing are taught. They have to think about how the layout and how the process should go exactly without causing further problems down the line.

Q. Okay. Were there mechanical engineering tools or methods or numerical techniques that you have at your disposal for modeling and determining the stresses on objects that you could have employed that you did not?

A. No, I did not have to do any of this. That's

what I am trying to explain.

Q. Yes, I understand that you are saying that you didn't feel you needed to do it.

A. Yes.

Q. I am just asking you, are there such engineering tools and methods and techniques that you could have employed, but chose not to?

A. In principle, if, you know, -- you know, if you study the problem in a lot of detail, you could try to involve, you know, numerical tools or something.

Q. Uh-huh.

A. But, again, you don't resort to these things, which are time-consuming and expensive, unless you think there is a need to do that. That's what we teach our students, you don't do -- go the time-consuming route and expensive route when there is no need to do that. That's a waste of time and money.

Q. And you felt here that there wasn't a need to do any of those kinds of techniques or methodologies?

A. No. You don't need to.

Q. Okay. Did you employ the finite element analysis in your work on this case?

A. No. That's part of numerical techniques that are very expensive. Again, you only employ it if you feel, you know, you have to employ it.

Q. Okay. Could the finite element analysis have been employed for estimating the stresses and stiffness and deflection of the RV steps in this case?

A. You could use numerical tools to estimate deflections, the exact stresses. It's probably hard to estimate, not just in this case, in a lot of cases, in practice, the exact stresses. This, again, requires a law of input for the problem. So, again, you don't do any of that. You know, there is no need to do all of this when it's clear what happened. So in this case, no, you don't need to do any of that.

Q. Did you perform any hand calculations to determine the stresses, stiffness, and deflection of the RV steps at issue in this case?

A. No, I did not do hand calculations, no.

Q. All right. Since you didn't employ any calculations, tell me how you could arrive at your conclusions without such calculations.

A. How I arrived at which conclusions?

Q. The conclusions that you have expressed in your report.

A. The evidence shows very clearly all the things I said.

Q. Okay.

A. That their welding process, they didn't

where the top link is, where you had the weld, where basically it broke the material next to it, and then there is another one on the other side also, there is another small ingress also, also caused by the welding.

Q. Okay.

A. And potentially the material selection, again, that I mentioned earlier, because some materials are more prone to hard phases or embrittlement, meaning more easier to break down the line.

Q. What do you know about the materials selection for this subject set of RV power steps?

A. I don't know the exact steel or material type involved, or alloy involved, but it appears that, you know, it is brittle, at least to some extent, that the cracks can run through it, can fracture easily.

Q. What prior experience do you have in evaluating the design or use of power steps of the type that we have in this case?

A. Not specifically these steps, but steps, in general, products, in general, components, in general. That's what we teach.

Q. Okay.

A. How they should be designed properly, how they should be manufactured properly, how they should be -- how would they fail in the existence of such

to power step design or manufacturing; is that correct?

A. Those specific steps, no.

Q. Okay. Did you inspect the specific steps that are the subject of this litigation?

A. Did I inspect them, yes.

Q. Okay. When?

A. Early in the case. I don't remember. It was 2012. Something like that.

Q. And where did you inspect them?

A. They were at the lawyer's office.

Q. At Jack Travers' office?

A. Yes, at the time.

Q. Who else was there with you?

A. I don't remember. I believe both of us were there. I don't remember if there was somebody else.

Q. Okay. For example, was his client, Nedra Denison, there, the woman who is the plaintiff?

A. I honestly don't remember. Her husband may have been there at one point. You know, I don't -- this has been awhile back.

Q. Okay. So tell me about what the process was when you inspected the steps and what happened during the course of that inspection.

A. So the process was -- I mean, these are foldable steps, okay? So you can unfold them. You can

open them up. So we looked at them in both states, as they fold or unfold, and I looked at the -- you know, the broken weld area. And so I examined that. And then what else? And, again, I did talk to Nedra, or mostly her husband, I guess, about what's going on, basically what happened.

Q. What information did you gather from Mr. Denison?

A. That she stepped on them, and when she stepped on them, she lost her balance and then she fell, broke her arm, and whatever, sprained her --

Q. Okay.

A. And then at the same time, he looked at it and found that there was basically a breakage there, a fracture, and he pointed it out to me, where the fracture area was. So I did see it. It looked like it was fractured, indeed.

Q. Did he give you any other information that you relied on for any purposes for the opinions you developed in this case?

A. I'm trying to remember. I don't think so.

Q. And do you recall what information Nedra Denison gave you, if any?

A. I mean, it was that, in a nutshell, I mean.

Q. Well, so far, you have not told me anything

Q. But you never actually physically saw them?

A. No, I did not physically see them.

Q. Okay.

A. The pictures, which are actually part of my report, shows them. They are of the motor home.

Q. Okay. Did you ever inspect any exemplar steps, steps that were from the manufacturer of the same kind of steps?

A. No.

Q. Did you interview any other witnesses besides the conversation you described with Nedra and Alan Denison?

A. No.

Q. Did you take any measurements during the course of your inspection of those steps?

A. I don't think I took measurements. Goff, the photographer, used some rulers to indicate scales and things in his picture, but I don't think I had to do any measurements myself.

Q. Okay. Did you use the photographs that have a ruler or a yardstick in them in any way in your analysis in terms of showing the scale, as you describe it?

A. They are there in my report, but I wasn't emphasizing necessarily in my report the scale. So I

A. Okay.

Q. This is where you describe your expertise that you bring to this case and the analysis that you conducted here. The first thing that you say is that "Dr. Khraishi is an expert in materials science/engineering."

Could you just briefly give me an overview of what your background is in that field of materials science/engineering?

A. What do you mean?

Q. Your educational and work history that relates to that field.

A. Okay. So I have a Ph.D. relating to materials science and materials engineering.

Q. Okay. And when did you get your Ph.D.?

A. And undergraduate courses also relating to that.

Q. When did you get your Ph.D.?

A. My Ph.D., in 2000.

Q. And from what institution?

A. Washington State University.

Q. And ever since then, you have been a professor at the University of New Mexico?

A. That's correct.

Q. Okay. And what is your title as a professor?

A. It's professor of mechanical engineering.

Q. Okay. And then you indicate that you are also an expert in mechanical design.

Can you tell me what you mean by that area of expertise?

A. Design of components and systems.

Q. Okay. And what is your background that you believe gives you --

A. Which is --

Q. Let me finish the question.

What is the background that you believe gives you the expertise to talk about mechanical design?

A. What is the background?

Q. Yes.

A. Because I studied those as an undergrad and graduate. So that's part of my study.

Q. Okay.

A. Throughout my college careers, all of them, as well as teaching. That's part of my teaching, both in design and in materials. So I teach these courses.

Q. Okay.

A. And these materials.

Q. And so that would be your educational background that contributes to your expertise in mechanical design?

A. That is correct.
Q. Okay. Do you have any work for any manufacturing company in mechanical design, any work experience in mechanical design for a company?
A. So I want to add another thing. It's not just my educational background, so where I took throughout my career courses and training in these areas, these specialties, but, also, my research areas. So I do research in all of these areas, as well.
Q. Is there any particular research that you have engaged in that you feel contributes specifically to your analysis of the problems in this case involving these power steps?
A. Specific ones, again, in general, yes. I mean, a specific one, I don't know, because I have done a lot of research and a lot of teaching. And I have taken a lot of courses.
Q. Okay. And I don't think I got an answer to my prior question.
A. Yes.
Q. Which was, do you have any work experience in working as a mechanical engineer who is involved in the design of products for a particular manufacturer?
A. Yes, at the research level and at the teaching level, yes, I have work experience.

Q. Okay. What is your work experience in assisting a manufacturer design a product?
A. I supervise students who design different products and teach them how to design them.
Q. Okay. Well, my question is your experience in working directly for manufacturers in designing products.
Do you have any experience in that?
A. Did I work for a manufacturer?
Q. Yes.
A. No.
Q. Let's talk a little bit about the next area of expertise that you describe here, which is "mechanics of materials."
Do you see that in paragraph two?
A. Yes.
Q. Tell me what you mean by that.
A. So mechanics of materials related to mechanical design. So mechanics of materials relates to different products, components, systems, when they are subject to physical forces, what happens to them, how do they respond, and what happens to them.
Q. Okay.
A. So that's a science and a field that engages in these.

Q. And I assume your expertise here comes from your educational background and the degrees that you have obtained in mechanical engineering; is that correct?
A. Yes, in addition to all the research I have done also in the area.
Q. Okay. And then the next area that you list is "manufacturing/fabrication techniques."
What do you mean by that?
A. How are things manufactured, engineering products, products in general, but specifically, engineered-type products, how are they manufactured. There are different techniques that can be employed for manufacturing different things and there are proper techniques versus non-proper techniques.
Q. Okay. And have you done any specific work as an educator in the field that specifically relates to the manufacturing or fabrication of power steps of the type in this lawsuit in the past?
A. Specifically, the power steps, no, but, again, this is a -- no, specifically for power steps, no.
Q. Okay. Is there any other area of expertise that you intend to draw upon in this case for opinions you intend to testify about in this case besides the ones you have mentioned here?

A. I don't believe so.
Q. Okay. Do you consider yourself an expert in industrial engineering related to power steps for motor homes?
A. Again, I am not specifically engaged in power steps.
Q. Okay. Generally, do you consider yourself an expert in human factors?
A. I know about human factors. That's part of the design process we teach, yes, we teach human factors, anthropometry. So we teach that part as part of the design, mechanical design.
Q. And what was the phrase that you used?
A. Anthropometry.
Q. How do you spell that?
A. A-n-t-h-r-o-p-o-m-e-t-r-y.
Q. And what is that?
A. It's also a study of human factors, basically.
Q. Okay. And tell me, when you talk about "human factors," what do you mean?
A. It means when you are engaged in design of products, the design should be suitable to an intended

A. That step, especially when you step on it, would come closer to -- so it would collapse onto each other, in other words.

Q. Did you take any measurements of how much closer, if any, the steps were?

A. No, I did not do any measurements.

Q. Okay. Why not?

A. I didn't have to.

Q. Why not?

A. I didn't have to. It was clear that by looking at this, it was bent down, by Figure 7, to look down, the step is going down.

Q. And how can you tell that from Figure 7?

A. I can tell. Figure 7 shows that the link has gone down.

Q. Okay.

A. In the vertical sense.

Q. Can you take this purple pen and -- you have the original exhibit, don't you?

A. Uh-huh.

Q. Yes. Can you take this purple pen and circle for me where you think it indicates that the link is going down in the manner you are describing?

A. It's going down here vertically.

Q. Okay. And you circled pretty much the whole

link.

Can you show me more specifically with maybe an arrow pointing to where you think it's going down?

A. It's going down here. This is how it's supposed to be.

Q. Okay. So you have drawn a line across to show how it's supposed to be?

A. Yes.

Q. Did you measure that change to the link to determine how much it was going down, as you describe it?

A. Did I measure the change, the degrees here?

Q. Yes.

A. No.

Q. And why didn't you measure that?

A. Again, I don't have to. It's very obvious that there is a tilt in all the pictures.

Q. Okay.

A. And when I saw it in person also.

Q. Okay. The next sentence in paragraph number one, "She suffered injuries, including acute distal radius fracture (broken right arm) and ankle injury (strain, sprain)."

Where did you get that information?

A. I believe it was interaction with the law

that you should recognize the need or identify the problem.

A. Yes.

Q. Do you see that?

A. Yes.

Q. Do you agree with that as a factor in performing the Scientific Method?

A. Yes, you have to -- there has to be a need, correct.

Q. And then the next step is to define the problem.

Do you see that?

A. Yes.

Q. Do you agree with that?

A. Yes, you should also try to define what the problem is.

Q. And then it moves on to collecting data.

Do you see that?

A. Yes.

Q. And it sounds like you would agree that you should collect data?

A. Yes, you should collect data, correct.

Q. And then it instructs us that the next step would be to analyze the data.

Do you see that?

A. Yes.

Q. And I assume you agree with that?

A. Yes.

Q. And then the next step it identifies is to develop a hypothesis or engage in inductive reasoning.

Do you see that?

A. I see that.

Q. And do you agree with that, as well?

A. Yes. I mentioned the hypothesis just a few seconds ago.

Q. Okay. And then it says that the next step in performing the Scientific Method would be to test the hypothesis or engage in deductive reasoning.

Do you see that?

A. Yes, if you have to, you do that, that's correct.

Q. And finally, it says you should select the final hypothesis.

Do you see that?

A. Yes. Basically, this is called a conclusion in a sense, yes.

Q. So you would agree that when you are performing that Scientific Method, you should engage in the steps that we see in Exhibit 42, it sounds like?

A. Yes, you should engage in steps like this,

that's correct.

Q. Okay. And so let's think about it in this case, you know, in this case, did you identify the problem?

A. Yes. There was a need, and the need was dictated by the accident that happened. So the problem, what exactly is the problem, that is what I was able to look into, and by inspection, the problem is there was a fracture, okay, and -- or, rather, instability in the steps that caused that fall to happen.

Q. Uh-huh.

A. And then in terms of the data, you have to collect -- again, I mentioned that earlier, you have to look at evidence, you have to look at what you have.

Q. Uh-huh.

A. So that's called "collecting and analyzing the data." So we did that, we looked at the steps carefully to see what's going on, why there is a tilt, why there is an instability that would cause somebody to trip.

So we looked at that, and that was part of all those pictures you saw in the report in terms of the -- we discovered all the ingress, and then there is further cracking on one side, the side that caused the

tripping, and what is the hypothesis for that, the hypothesis is what is listed here.

Q. In your report?

A. Yes, in the report, that this could be due to, you know, the material choice. You know, they could have chosen material, for example, that is more prone to embrittlement, that's a hypothesis here.

Q. Okay.

A. And the other one, that this is a heat-affected zone. Again, this relates to the welding spot area, that there is a heat-affected zone where the embrittlement happened.

Q. Okay.

A. And there is potentially martensite inside of the microscopic lever.

Q. Okay.

A. But the other hypothesis could have been that there was not proper heat treatment, which I mentioned earlier. For example, there is a proper cooling rate, you know, that you have to do for welding so that you will try to avoid the formation of brittle phases.

Q. Okay. Did you test --

A. So this is all part of the hypothesis.

Q. Okay. And does that cover the hypotheses that you developed in your evaluation of the evidence?

A. I believe so, yes.

Q. Okay. What did you do to test each of your hypotheses?

A. To test which one?

Q. Each one.

A. I did not test for martensite.

Q. Okay. Why not?

A. In this case, you didn't have to, again, because there was ingress, followed by further cracking or fracture that caused the steps to clearly be tilted and not be even, level, and cause a fall for an unexpecting person, or if it happened immediately at that time, the further cracking.

Q. And what information did you rely on for reaching that conclusion that you did not have to test for martensite?

A. I already told you. I already told you. First of all, it is known that steel, in general, could form martensite, especially if it is not heat-treated well, or if they are welded and they are not given the proper cooling rate. This is established information that people teach in their courses.

Q. Okay.

A. So I don't necessarily, you know, have to look for that, but the fact that there is a fracture

and there shouldn't be a fracture in these areas points a finger to the way they did the welding, where they caused an ingress and then the further cracking.

My hypothesis has to do with there is an embrittlement happening there and the ingress existence. The ingress existence, itself, according to what is taught to everybody, can cause further cracking by itself. So if you combine that with the possibility of martensite, even a brittle phase locally there, more brittle than the other parts of the steel, that that even makes things worse.

Q. Okay. So let's focus just on the martensite for the moment.

A. Yes.

Q. You have testified today that it's "potentially there" and that it's "possibly there."

As I understand your testimony, you have not actually determined that the martensite is present in this steel; is that correct?

A. No, I have not determined that.

Q. Okay.

A. Or other brittle phases also.

Q. Okay. What would you have to do to determine that there is martensite present in the steel?

A. So, again, there might be another brittle

phase. What do I have to do? I have to do a microscopic examination.

Q. And would that involve destructive testing?

A. Yes. Yes.

Q. So you would have to cut open the steel?

A. Break and cut open, yes, correct.

Q. And then what would you do after you cut open the steel?

A. You would have to do grinding and polishing and then microscopy and then maybe even high-end microscopy, where you can look at the martensite structure.

Q. Okay. And you did not do that here because you felt it was not necessary?

A. No, I felt it was not necessary.

Q. Okay. And I believe you have also testified that there is possibly embrittlement here.

A. The embrittlement is related to the martensite or another phase.

Q. What would you have to do to -- in other words, you don't know for a fact that there is embrittlement in this steel; is that correct?

A. Not on the micro level, no.

Q. Okay. And why didn't you conduct the analysis to determine whether there actually -- let me

finish the question.

A. Yes.

Q. Why didn't you conduct the analysis necessary to determine whether or not there is actually embrittlement present in this steel, as well?

A. I mentioned earlier that steel, in general, especially when you are doing welding, you know, you could end up with steel formation of martensite, especially if you're not doing the proper heat treatment or cooling rate.

So that's part of it, but, also, the -- what do you call it? In this particular case, you don't have to, because there was a large -- the large cracking is causing the instability, the large fractures that happened, which caused somebody to lose their balance, especially if they are unexpecting and stepping on it while not knowing this already happened, or happened once, they stepped on it, and then the crack grew suddenly, because crack growth can be quick, it doesn't have to be slow, especially when it's stress-related.

Q. So is it fair to say that you cannot say to a reasonable degree of engineering probability that there is martensite in this steel?

A. Do I know for a fact there is martensite or

other brittle phases, there are indications of it, but I cannot tell 100 percent if there is without doing the examination, the microscopic examination.

Q. I appreciate that, but my question is a little different than that.

A. Yes.

Q. I am asking you whether, to a reasonable degree of engineering probability, you can say whether or not martensite is present in this steel without doing the destructive testing that you described.

A. There is probably some brittle phase. I can say that, there is brittleness. There is probably some brittle phase with the martensite or another phase brittle locally there in that area.

Q. So as I understand it, you can't say to a reasonable degree of engineering probability that martensite is present in this steel?

MR. TRAVERS: I'm going to object.

Q. (By Mr. Erickson) Go ahead and answer the question.

A. I think there might be some. I cannot tell 100 percent, but I think there might be some brittle phase, yes.

Q. Okay.

A. There might be if it's examined.

Q. And what do you mean when you use the word "might"?

I mean, how likely is "might"?

A. Fifty percent.

Q. Okay. And there might not be 50 percent, too, right?

A. There might not be, yes.

Q. Okay.

A. Yes. Again, you cannot tell these things. There is an indication that there is because of the way the fracture looks like a brittle fracture. There are different types of fracture. This type of fracture is what I would call a brittle type fracture because of the way it looks.

Q. And turning back to your report, Exhibit 41, can you show me in a photograph what about the appearance of this fracture makes you think that it's a brittle fracture?

A. Yes. So the way -- for example, if you look at Figure 3, do you see here how it's -- it is sharp, the fracture is sharp and pointed?

Q. Why don't you circle that area with the purple pen on Figure 3 that you were just pointing to?

A. This area here.

Q. Can you try to make it a little darker, if

look more blunt.

Q. Okay. Do you see any features in Figure Number 3 of this being a ductile fracture? I'm looking at Figure 3. We can look at other ones, too, but I want to ask you about Figure 3 since we are on it.

A. Yes, I know. I know. It's not. The angle is not as easy as the other ones.

Q. Okay.

A. But yes, again, it looks more brittle to me, like I said, just by looking at it.

Q. Okay.

A. Again, brittle and ductile, it's not a sharp delineation between them, the way they are defined in the literature. People just talk about them. And normally, when they describe them, they describe them in the extremes, meaning a good example of brittle is a glass breakage, you know, typical glass.

So they tell you, "Okay. Look at this surface, see how it is a clean-cut, more faceted-type face or surface of the structure," and it's not as rough if you try to punch it, and a roughness also indicates shininess in terms of metal. So if it's rough, it's not as shiny as if it is more flat.

Q. Okay. My question is just whether, in Figure Number 3, you see any features that suggest a ductile

fracture at all. I recognize that different pictures can show different things.

A. Yes. Again, I cannot tell you the degree of embrittlement or the degree of ductility, which is the opposite of embrittlement. So the exact degree, you know --

Q. And I am not asking for an exact degree.

A. Yes.

Q. I am just asking whether, when you look at this fracture that we see in Figure Number 3, are there any -- is there anything there that suggests to you that this was a ductile fracture?

A. The way I'm looking at it myself, it looks more of a brittle fracture.

Q. Okay.

A. That's the way I look at it.

Q. The next question is, what's the significance of finding a brittle fracture as opposed to a ductile fracture?

A. Good question. I wrote in the report, and I believe I touched on it previously today, if something is brittle, especially if it already has a notch in it or an ingress, okay, so if it has some brittleness to it, it could cause easier breakage down the line.

So if you apply forces later to that area,

A. No, not the very specific details, no.

Q. Okay. Then on March 11th, 2015, it says, "Working on the federal report and other docs, e.g., fee schedule, plus communicating with John."

Do you remember what you discussed on March 11th of this year?

A. So, I mean, again, whatever it says here, that I was asked to produce a report, and then, for example, there was a fee schedule document he asked me to produce.

Q. Okay.

A. So I e-mailed him or I talked to him on the phone. Sometimes communication was over the phone. Many times it was over the phone, actually.

Q. Okay. Dr. Khraishi, we talked about what your hypotheses were this morning.

My question is, did you consider other hypotheses and evaluate them as required by the Scientific Method that we have talked about?

A. No. These are the hypotheses listed here in my report.

Q. Okay. Why didn't you consider other hypotheses?

A. Because this is what I can hypothesize myself, is what I managed to hypothesize, is these

ones.

Q. Okay.

A. I don't have to consider anything that doesn't come to mind.

Q. Okay. And as I understand it, you performed no testing to evaluate your hypotheses; is that correct?

A. I did not do microscopic-type testing, because, again, that's not important for what caused the fall.

Q. Okay.

A. So it could have contributed to it, yes, you know, but, again, what caused the fall is the existence of the cracking that destabilized her. So that's what caused it, but the other thing is more an "Okay. What may have been going on there right there on the spot." That's the hypotheses.

Q. Okay. And my question wasn't limited to microscopic testing.

A. Yes.

Q. My question was, you didn't perform any testing to evaluate your hypotheses?

A. No, I did not do testing.

Q. Okay. Did you reach -- well, let me ask the question this way.

Q. Did you determine to a reasonable degree of engineering probability that there was, in fact, improper heat treatment of the weld area on this brace in question?

A. Yes. I mean, I believe so, the way the fracture happened.

Q. And what methodology did you employ to make that determination?

A. Again, concepts and knowledge of fracture mechanics and fractography, how fractures happen and how they look, how do they look, those fractures, so you could shed some light on that.

Q. Do you know whether the subject steps that we have been talking about or any of its components actually received a post-weld heat treatment?

A. Do I know, no.

Q. When you were evaluating the various hypotheses that should be evaluated in this case, did you consider whether the post-incident condition of the steps was consistent with an overload such as Ms. Denison falling on the steps?

A. What's that?

MR. ERICKSON: Denise, would you read the question back, please?

MS. KOPAN: "When you were evaluating the

meteorite hitting the site and the other was her falling, and I don't think we have any suggestion -- let me finish.

I don't think we have any suggestion that a meteorite hit the site, but we do know that, according to her story, she fell on that day.

A. No, I don't know that story, that she fell. All I know is she fell off of it.

Q. Did you consider whether there was any kind of overload on the steps that caused the damage to the steps that we see?

A. No, I did not consider overload, because, again, I was not told there was any overload.

Q. Okay. Do you believe that the condition of the post-incident steps is consistent with an accident in which Ms. Denison fell on the steps as she exited the RV?

A. Can you repeat that again?

Q. Yes. Do you believe that the condition of the steps after the accident was consistent with an accident in which Ms. Denison fell on the steps as she exited the motor home?

A. I mean, I cannot talk to that, to falling, because that's not what I know, that there was a falling or anything on the steps.

Q. Okay. Well, I am just asking you whether the condition of the steps could be consistent with a falling or an overload on the steps.

A. Again, I cannot answer hypothetical questions because you can ask me many things, like a bear fell from the top of the RV, is this consistent with that. I cannot answer that hypothetical question. So I don't know.

All I know is this -- is what I was told, that she fell and lost her balance and she fell, but, again, what caused that, my hypothesis is there is an initial ingress, and that ingress could grow, you know, with something as tipping on it over time, because you cannot control these things. It's not like, "Okay, it's going to happen in the next second or next" -- you know, it's hard to know when it's going to happen, the further progress. So no, I did not.

Q. Okay. Did you do anything to rule out overload as a failure mechanism in this incident?

A. Did I do anything to rule out?

Q. Yes.

A. No, I did not do anything specific to rule out what the cause was.

Q. Okay. So in paragraph three of your report at Exhibit 41, you state, halfway through the

paragraph, this is on the very first page, paragraph number three, you state two different possibilities. You state, for example, it could indicate what you see in this zone of brace, it could indicate an embrittled material with martensite formation in the steel, and then you go on to say, "Also, it could indicate improper heat treatment of the weld area after welding to avoid brittle spots."

Did you make a determination to a reasonable degree of engineering probability that either one of those possibilities actually is the one you believe occurred?

A. Yes.

Q. And what decision did you make?

A. That one of them occurred for sure, if not both.

Q. And my question --

A. Again, the point I need to keep emphasizing is this is a hypotheses on the microscale. Microscale is normally one word. So, again, the existence of the ingress, the initial fracture, by itself, is detrimental to the structure integrity of the link and the steps and could cause further propagation or growth of the crack that we have seen already in the different-colored surface, one rusted, one not rusted.

And so, again, this could be the underlying cause of why, you know, it fractured further, is because the material type is prone to martensite or bainite, which is another phase, another brittle phase, or, you know, they did not heat-treat it properly. So that also could cause brittle -- or embrittlement, the brittle phases.

Q. But as I understand it, you have not made a decision as between those two possibilities as to which one actually occurred in this case?

A. You know, I am not sure which one occurred, no, I am not sure, but, again, one or the two or both occurred.

Q. Let's move on to paragraph four, the next paragraph down. And it appears to me that you stated it essentially twice; it's the same opinion. In the second full sentence at the top of paragraph four, it says, "On the left side of the picture," referring to Figure 1, "there is a top link that broke and caused Nedra's losing balance."

Do you see that sentence?

A. Yes.

Q. And then at the end of the paragraph, it says, "The loss of stiffness in the structure due to this large crack caused Nedra to lose her balance and

expert who can opine on a person's balance and causes for loss of balance?

A. I am not an expert on just balance and causes of balance, but, again, the documents that you have, and, like you said, people, themselves, who have experienced that know you can have loss of balance from misalignments and where they are stepping and uneven surfaces.

Q. Okay. Did you measure or calculate the loss of stiffness that you describe in the steps in paragraph four of your report?

A. Did I measure or calculate? No. It's actually obvious. You don't have to calculate it, because the -- that's why, when you look at the stairs, they are hanging on the RV, they are tilted. The reason they are tilted, this is a loss of stiffness. They are not as stiff as they were before the large crack, in other words.

Q. Did you know what the stiffness of the steps was before the accident?

A. No, because it depends on how you want to define "stiffness" and how you want to measure stiffness and all of that. Again, these are technical jargon. When you say technical stuff and you are trying to quantify them, then that's different.

Q. Do you know whether the steps tilted at all prior to this accident?

A. Prior to the accident, no. I am assuming they were not tilted; otherwise, they wouldn't lose their balance when they are going up and down, both of them, for a period at least until that happened, then this must have happened.

Q. Are you aware of the fact that they continued to use these steps after the accident without falling from them?

MR. TRAVERS: Excuse me?

Q. (By Mr. Erickson) My question was whether you are aware of the fact that Mr. and Mrs. Denison continued to use these steps on this mobile home after the accident without incident or fall.

A. They continued to use them? I don't know if they continued to use them or not.

Q. Yes. Let's move on to paragraph five of your report. The first sentence, I just want to make sure what you are referring to.

A. Yes.

Q. It says, "Upon further examination of the right side of the steps that did not have this large crack."

Do you see that?

A. Yes.

Q. And with reference to the phrase "even by a few degrees," my understanding is you didn't make any determination of what the measurements were regarding the change that you have identified in horizontal level; is that correct?

A. I did not measure the exact degrees of tilt, no.

Q. And, again, you're not testifying as a human factors expert in this case about Nedra's loss of balance; is that correct?

A. You know, again, I am not. I have expertise in human factors and anthropometry, but I am not here trying to argue.

MR. TRAVERS: Can we have a break? I need to answer this.

MR. ERICKSON: I want to finish this line of questioning first.

THE WITNESS: Yes.

Q. (By Mr. Erickson) Okay. You don't know how level the steps were prior to the incident, in other words?

A. No, I did not see them prior.

Q. Do you know what the threshold is or tipping point in terms of loss of horizontal leveling that

potentially -- it is a stress concentration area, we call it, meaning it is more prone to fracture.

On top of that --

Q. Can I just ask you a question?

MR. TRAVERS: I'm going to object. Let him finish.

MR. ERICKSON: I'm going to let him finish, but I also want to ask him before we move on to his next point.

MR. TRAVERS: But you can't interrupt him until he is finished.

Q. (By Mr. Erickson) Okay. Go ahead.

A. So that's part of it. The other part is they may not have used the best materials for the step. In which sense, again, in the sense that they used one that is more prone to brittle phases inside, to the formation of brittle phases.

And there is another aspect to it, is even if they used okay materials, did they not properly heat-treat it. To make sure they do not allow for brittle phases inside, they have to properly heat-treat and use, you know, cooling grade that is low to avoid this and do an annealing process, a-n-n-e-a-l-i-n-g, again, to improve the fracture toughness of the material.

Because this is a known problem, is when you do welding, you could embrittle the material, especially in the heat-affected zone like I mentioned in the report. So they need to do a combination of all of these things really to ensure that hey, this is not going to create problems down the line and fracture and all of this.

So what's your question?

Q. Yes. My specific question about the welding component of what you were talking about is, what was wrong about the welding, as you see it, that resulted in this initial ingress that you have identified in the brace?

A. Oh, what was wrong about it?

Q. Yes.

A. So the way they placed it -- again, this is part of the overall design, the way they placed it. You see the bead here?

Q. You're looking at Figure what?

A. Let's look at Figure 4, for example.

Q. Okay.

A. Although Figure 3 also kind of shows it. So when they put the weld -- you see this?

Q. Yes.

A. Because it's a heating source, directed

heating source. So they could easily put it, and then -- on here, it's hard. Oh, here it is. This is a better picture, Figure 5. Figure 5.

Q. So why don't you circle for me on Figure 5 with one of the colored pens where the weld is that you are concerned about.

A. Yes. So here. You see, when they put this, so with a torch, they could cut right into that. Here, they could not cut in the middle; why, because of the way it is, it's continuous on both sides, but where it's discontinuous, where it stops, okay, and where it stops is basically hanging in the air, it's basically like a cantilever under it. So this is dangerous and they could create a problem right there.

Q. So just to make the record clear, I want you to circle the area that you are talking about in red.

A. In Figure 5?

Q. Try the purple one, too, and see if that shows up better.

A. Which one, this?

Q. Yes. Okay. That's better. Thank you.

Okay. So with respect to the materials, as I understand it, you don't actually know the specific alloys of the materials?

A. No, I do not know the specific alloy.

A. Yes, Figure 5. When they went all the way to the end here, that's where the danger is. They could have done that cut, the one where it's hanging basically over air.

Q. By the "end," you mean the edge over which the brace or the link is attached to the crosspiece?

A. This is the link, I am calling this.

Q. Yes. The whole thing?

A. With the arm, I think, or what is this? Yes. Is this the arm? One of them is the arm, one of them are the steps -- the step, see?

Q. Okay.

A. Yes. Yes. I mean, here, Figure 7, but, anyway, the point is that that's part of the problem, I think, is they went too far into it and they created a cut, but the other problem, again, is the type of steel. Did they use the tough one that doesn't, you know, fracture as easily, did they also heat-treat it, because welding like this, in general, you have to heat-treat it properly. Otherwise, you run the risk of getting those hard phases that -- the brittle phases.

Q. And you don't know whether they heat-treated it or not; is that correct?

A. I don't remember if I learned that, no.

Q. All right. Have you reached any conclusion

loading, will pop it through.

So that's part of fracture mechanics theory and education, is -- especially in brittle-type materials, you could get -- the crack would go very quick. So, again, there is a difference between the initial ingress, which I believe was put in there by mistake by them, they didn't know what they were doing, and by the other crack which has caused the tilting of the whole step and destabilization, and that happened afterwards.

Q. Are you aware of any other similar steps failing in the way that you have described?

A. No, I am not aware of similar steps. I have not been involved in step cases like this one, and most of these cases, when they settle, they are not public, anyway, and nobody knows about it.

Q. Did you rely on any other materials other than what we have talked about today in developing your opinions that you have expressed in your report and in your testimony today?

A. No, I don't believe so. I mean, again, there were some e-mails back and forth, but I don't think --

Q. Between you and Mr. --

A. Yes, my opinion was based on evidence and the

Scientific Method, and, you know, my expertise and knowledge of different fields of fracture mechanics, solids mechanics, materials science, engineering design, manufacturing.

So no, I don't think there were any other things than what we have, and, of course, examining the actual steps first, that was a big part of it, which is, again, part of the Scientific Method.

Q. And as I understand it, you have not developed any alternative design to the design of these steps that you would consider to be a safer design; is that correct?

A. No, I would not develop that, unless somebody pays me a good amount of money, then I will engage in step design.

Q. Have you been asked to perform any additional work or analysis on this case prior to trial by Mr. Travers?

A. Prior to trial?

Q. Yes, prior to trial.

A. What do you mean, "prior to trial"?

Q. Well, for now, until trial occurs, if there is a trial.

A. Yes.

MR. TRAVERS: I mean, if we get the steps